Indian J.Sci.Res. 6(2) : 125-130, 2015

ISSN : 0976-2876 (Print)
ISSN : 2250-0138 (Online)

STUDY OF LUMBAR LORDOSIS AND PELVIC POSITION IN BHARATANATYAM DANCERS

SHRADHA PAWAR[a1] AND UNNATI PANDIT[b]

[a]Master in Physiotherapy, D. Y. Patil School of Physiotherapy, Mumbai, Maharashtra, India
[b]Director, D. Y. Patil School of Physiotherapy, Mumbai, Maharashtra, India

ABSTRACT

Bharatanatyam is one of the most ancient dance forms in India. This dance style is characterized by a linear form of the body without any pronounced movement of the upper body and linear spatial patterns, which make the dance form extremely dynamic and powerful. Wrong adaptation of this posture could impose an excessive stress on the spine, especially the lumbar spine, and result in pain, disability among the dancers. This study was undertaken to assess the lumbar curvatures and pelvic inclinations in bharatnatyam dancers. A preliminary study on the prevalence of low back pain in bharatanatyam dancers was found to be nearly 45%. There are evidences that show increased lumbar lordosis and pelvic inclination can lead to low back pain. From our study it can be concluded that the lumbar lordosis angle and the pelvic inclination angle in bharatanatyam dancers is more than the non-dancers. We also proved that there is linear correlation between the two measurements which explains the pelvic posture and the lumbar spine posture in bharatanatyam dancers.

KEYWORDS : Lumbar lordosis, Pelvic inclination, Flexirule

Musculoskeletal injury is found to be an important health issue for dancers at all skill levels. Although types and patterns of dance styles are different, it has been found that the most common injuries reported are of the back and lower extremities. Bharatanatyam is one of the most ancient dance forms in India. This dance style is characterized by a linear form of the body without any pronounced movement of the upper body and linear spatial patterns, which make the dance form extremely dynamic and powerful. The dance is performed on the stage as “Nrittam”, “Nrithyam” and “Natyam”. The foundation of the pure dance form (Nritta) consists of basic steps known as “adavu”. “Sthanakam” (posture) is one of the components of adavu which comprises of 3 basic positions namely – “Araimandi” (half sitting position), “Muzhumandi” (full sitting position) and “Standing”. Majority of the adavus are performed in the Ardha mandali position- the basic stance of this art form in which the torso is held erect with the legs bend at the knees and feet are flexed sideways, horizontally in a line with a distance of one span between the heels. This position requires the dancer to compress one's height to at least 3/4th of their original height. This basic stance in Tamil is referred to as Araimandi, literally meaning the half-sitting posture. It has been noticed that, the half sitting position (“Araimandi”) is the main position maintained for the longest duration in the dance style.

Wrong adaptation of this posture could impose an excessive stress on the spine, especially the lumbar spine, and result in pain, disability among the dancers and also result in increased absenteeism from dance training sessions. Practice of a faulty posture for a long time in one's dancing career could also result in a permanent structural change. Hence this study will focus on studying the lumbar spine curvature and pelvic inclination in standing and correlate both. Pelvic tilt is defined as the angle between the horizontal plane and a line passing through the midpoint of the posterior superior iliac spines and the midpoint of the ASIS. Lumbar lordosis is the curve assumed by the lumbar spine, where the lumbar spine forms an anterior convexity. The degree of lumbar lordosis is variable among individuals and is the result of many factors, including the fact that the L_5 vertebra is wedge-shaped, with the anterior aspect of the vertebral body being approximately 3mm higher than the posterior aspect. The intervertebral discs in the lumbar area are also wedge-shaped, especially at the L_4-L_5 and L_5-S_1 segments. The intervertebral disc at the L_5-S_1 interspace has been measured to be 6-7mm higher anterior than posteriorly. The vertebrae above L_5 are less wedge-shape of the L_5-S_1 vertebral levels, each vertebra above this level lies slightly behind the vertebra above. Evidences suggest the use of a Flexi Curve ruler as a tool to assess the lumbar spine cuvature. Hence this study also will attempt to find out what will be the probable relation between the alterations in

[1]**Corresponding author**

lumbar curvature and prevalence of low back pain among the Bharatanatyam dancers(Oliviera TS et al 2012).

Thus this study was undertaken to assess the lumbar curvatures and pelvic inclinations in bharatnatyam dancers. A preliminary study on the prevalence of low back pain in bharatanatyam dancers was found to be nearly 45%. There are evidences that show increased lumbar lordosis and pelvic inclination can lead to low back pain.

Study Design

Inclusion Criteria

Bharatanatyam dancers from 5 dance institutes of Kalyan were included: Natraj nrutya vidyalay, Dinkar sangeet vidyalay, Yadnavalkya dance institute, Sangeeta nrutya vidyalay, Avishkar nrityakala The study type was correlation study in which a total of 80 subjects were selected out of which 40 subjects belonged to experimental group and 40 subjects belonged to control group. The experimental group included bharatanatyam dancers practicing since 3yrs or more and in a age group of 18 to 30 yrs. The control group included non dancers from same age group.

Exclusion Criteria

Dancers with history of surgery or any musculoskeletal injuries in past 1 year were excluded.

Duration of Study - 6 months

Informed consent was obtained from all subjects prior to the study. Questionnaire was filled by the subjects. The subjects were grouped as follows-

Group 1 - Bharatanatyam dancers

Group 2 - Age matched non dancers

Measurement Tools

A pelvic inclinometer, a flexirule, a measuring tape, a weighing machine, a marker pen, Drawing book, Pencil, Pen, Ruler.

METHODOLOGY

Measurement With Pelvic Inclinometer

The angle of pelvic inclination in the sagittal plane was defined as the angle with the horizontal plane and a line passing through the posterior superior iliac spine (PSIS) and the anterior superior iliac spine (ASIS). The degree of pelvic tilt is measured as follows:- The location of the ASIS and thePSIS are determined by examination and palpation and marked with a felt tip pen. One end of the tip of the caliper of the pelvic inclinometer is placed over the ASIS and the second tip over the PSIS of the same ilia as shown in figure. Then we have to bring the closed end of the calipers to a position such that pendulum hangs between the protractor and its back plate.

Measurement With Flexirule

Lumbar lordosis is the curve assumed by the lumbar spine, where the lumbar spine forms an anterior convexity. The subject was asked to stand in a relaxed position with the low back and upper buttocks exposed. The subjects were told to distribute their weight evenly, with their feet 10-15 cm apart. The subjects stood with their arms at their sides and their head facing forwards. Then palpate the spinous processes of L_3 and S_2 and mark them with small paper adhesive markers. The spinous process of L_3 was located using the following method- the L_{4-5} interspace was located on an imaginary line approximately midway between the superior aspects of the two iliac crests. The tester then palpated two spinous processes up from this space to locate the L_3 spinous process. A marker was placed over this process making sure the line on the marker was horizontal. Next the examiner palpated the S_2 spinous process, which was assumed to be midway between the inferior aspects of the posterior superior iliac spine (PSIS). An adhesive marker was placed over the centre of the S_2

Table 1 : Observational Analysis for Pelvic Inclination and Lumbar Lordosis

Pelvic inclination angle	Group	N	Mean	Standard Deviation
	Experimental	40	8.05	1.108
	Control	40	5.8	1.620
Lumbar lordosis angle				
	Experimental	40	58.504	12.856
	Control	40	48.035	14.116

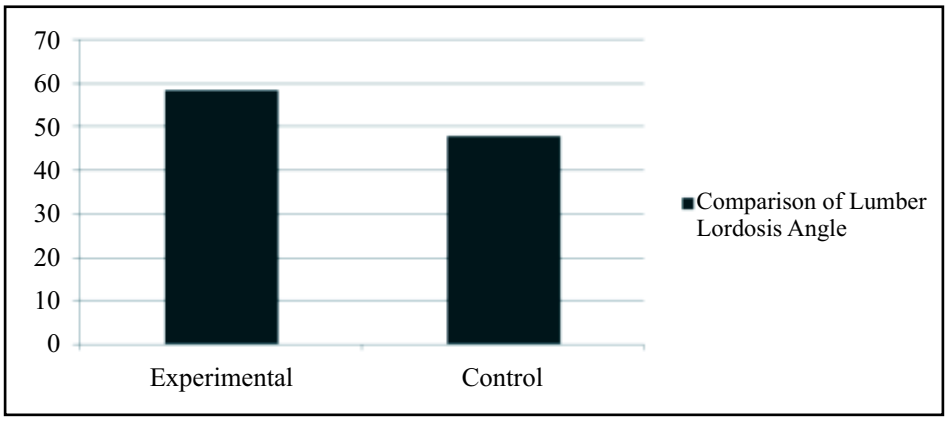

Figure 1 : Comparison of Lumbar Lordosis Angle

Dependent variable			P value	Significance
Lumbar Lordosis Angle	Experimental	Control	0.0008	Extremely significant

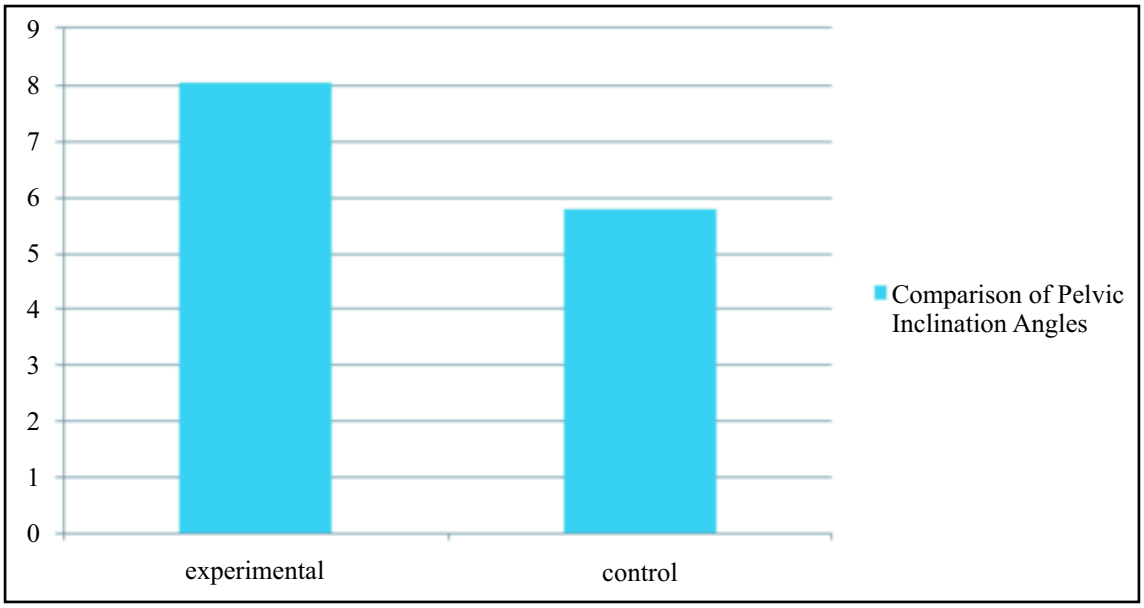

Figure 2 : Comparison of Pelvic Inclination Angles

Dependable variable			P value	Significance
Pelvic inclination angle	Experimental	Control	<0.0001	Extremely significant

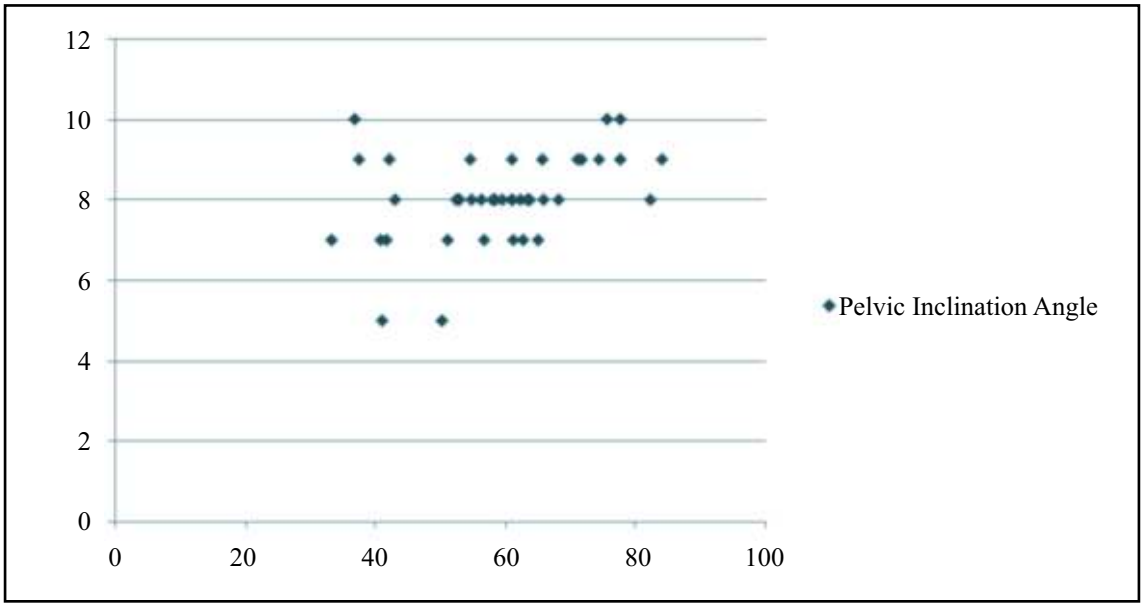

Figure 3 : Pelvic Inclination Angle

		Lumbar lordosis angle
Pelvic inclination angle	Pearson correlation coefficient	0.3904
	Sig.(2 tailed)	0.0128
	N	40

spinous process keeping the line on the marker horizontal. The flexirule was then placed over the spinous process of the low back and shaped to its contour. The markings on the flexirule were noted. The tester then carefully removed the flexirule so as not to distort the shape. The outline of the curve was traced onto the paper, and the markings that corresponded to the L_3 and S_2 levels were labeled as point A and B respectively. The length of the line (L) drawn from the point A to point B was measured. The length of a perpendicular line (H) drawn from the midpoint (L) to the curve was then measured with a ruler. These two measurements (L and H) were then recorded on the data form by the tester performing the measurements. An angle, theta was then determined by using these measurements in the equation:

$$\text{Theta} = 4 \times [\arctan (2H/L)$$

Where theta represents the magnitude of the lordotic curve.

OBSERVATION AND RESULTS

Interpretation

The mean and standard deviation of lumbar lordotic angle and the pelvic inclination angle of experimental and control group were calculated. The lordotic angle in the experimental group measured a mean angle of 58.504 degrees. The lordotic angle in the control group measured a mean angle of 48.035 degrees. The pelvic inclination angle in the experimental group showed a mean angle of 8.05 degrees. The pelvic inclination angle in the control group showed a mean angle of 5.8 degrees in table 1.

Comparison Between Lumbar Lordosis Angle Within Both Groups

Unpaired t-test was used for comparing the lumbar lordosis angle within both groups: An extremely significant difference was seen in lumbar lordosis angle of bharatanatyam dancers compared to non dancers (Figure 1).

Comparison of Pelvic Inclination Angle Between Both Groups

Unpaired t-test was used for comparing the pelvic inclination angle within both groups: An extremely significant difference was seen in pelvic inclination angle of bharatanatyam dancers compared to non dancers (Figure 2).

Correlation of Lumbar Lordosis and Pelvic Inclination

A Pearson's correlation coefficient was used in our study to measure the strength of correlation between the lumbar lordosis and pelvic inclination. Pearson's correlation ranges between -1 to +1 with -1 stating negative correlation, +1 stating positive correlation and 0 states no linear relationship between the two (Figure3).

In our study we got the Pearson's correlation coefficient as 0.3904. Thus we can see there is positive correlation between lumbar lordosis and pelvic inclination.

DISCUSSION

Comparison of lumbar lordosis angle and pelvic inclination angle in Bharatanatyam dancers was found to be extremely significant with a P-value of 0.0008 and <0.0001 respectively. There was a positive correlation between lumbar lordosis and pelvic inclination in bharatanatyam dancers. The degree of lumbar lordosis is variable among individuals and is the result of many factors, including the fact that the: L_5 vertebra is wedge, The intervertebral discs in the lumbar area are also wedge-shaped, especially at the L_4-L_5 and L_5-S_1 segments. In optimal posture, according to Kendall and McCreary, the hip is in the neutral position and the pelvis is level with no anterior or posterior tilt. In a level pelvis position, lines connecting the symphysis pubis and the ASIS are vertical and the lines connecting the ASIS and PSIS are horizontal. In this optimal position, the LoG passes slightly posterior to the axis of the hip joint, through the greater trochanter. In a posture in which the pelvis is excessively tilted anteriorly, the lower lumbar vertebrae are forced anteriorly. The upper lumbar vertebrae move posteriorly to keep the head over the sacrum, thereby increasing the lumbar anterior convexity (lordotic curve). Ideally, when the hips are flexed, the traction on the human hamstrings tends to tilt the pelvic posteriorly relative to the sacrum(I.A.Kapandji). This is therefore a movement of nutation, which decreases the antero-posterior diameter of the pelvic brim and increases both diameters of the pelvic outlet. But according to our study, due to faulty adaptation of Araimandi posture during bharatanatyam dance the pelvis tilts anteriorly. This causes an increase in the lumbar lordosis. So due to this there is compression on the posterior aspects of vertebral bodies & facet joints,intervertebral foramina narrowed and the interdiskal pressure at L_5 to S_1 is increased. Also there is stretching of the abdominal muscles and the anterior longitudinal ligaments. The iliopsoas & lumbar extensors tend to shorten along with the posterior longitudinal ligament, interspinous ligaments and ligamentum flavum . The psoas major runs from the lumbar transverse processes, the anterolateral vertebral bodies of T12 to L4, and the lumbar intervertebral disks to the lesser trochanter of the femur. It courses inferiorly and laterally, and the distal tendon merges with that of the iliacus. The primary role of the psoas major is flexion of the hip. McGill reported that it is active only when there is active hip flexion. The iliacus runs from the iliac crest over the pubic ramus to the lesser trochanter with the tendon of psoas major. The role of the Psoas major at the lumbar spine appears to be to buttress the forces of the iliacus, which, when activated, cause anterior tilting of pelvis and thus lumbar spine extension. This may be the cause of prevelence of low back pain in bharatnatyam dancers. The shearing forces at L_5 to S_1 also increases the likelihood of forward slippage of L_5 on S_1(Pamela Levangie et al). In our study, Correlation of lumbar lordosis and pelvic inclination showed the Pearsons correlation coefficient as 0.3904 which shows a positive correlation between lumbar lordosis and pelvic inclination angle. Thus we can conclude from this that probably when iliacus and psoas major are shortened during repeated hip flexion movements as in araimandi position, it causes anterior pelvic tilt and increased lumbar lordosis which in turn causes imbalances in trunk flexors and extensors and could be the probable cause for low back pain(Youdas et al 2000).

CONCLUSION

From our study it can be concluded that the lumbar lordosis angle and the pelvic inclination angle in

bharatanatyam dancers is more than the non-dancers. We also proved that there is linear correlation between the two measurements which explains the pelvic posture and the lumbar spine posture in bharatanatyam dancers. The theoretical findings in the belief that deviations in the lumbar lordosis are contributing factor to low back pain. Thus clinically it is of grave importance that pelvic postures and lumbar spine postures should be assessed in Bharatanatyam dancers to acknowledge their problems and correct their abnormal postures and the imbalance in the trunk flexor and extensor equilibrium.

REFERENCES

Oliveira T. S., Candotti T. C., Torre L. M., Pelinson TPP , Furlanetto S. T., Kutchak M. F. and Loss F. J., 2012. Validity and Reproducibility of the Measurements Obtained Using the Flexicurve Instrument to Evaluate the Angles of Thoracic and Lumbar Curvatures of the Spine in the Sagittal Plane. Rehabilitation Research and Practice. Feb; Article ID 186-156.

Youdas J. W., Garrett T. R., Egan K. S., Therneau T. M., 2000. Lumbar lordosis and pelvic inclination in adults with chronic low back pain. Phys Ther; **80**:261–75.

Youdas J. W., Garrett T. R. and Harmsen S. et al., 1996. Lumbar lordosis and pelvic inclination of asymptomatic adults. Phys Ther ; **76**:1066–81.

I. A. Kapandji-The Physiology of the Joints volume three, second edition.

Pamela K. Levangie, Cynthia Norkin-Joint structure and Function- A compressive analysis.